P&A OPERATIONS AND THE EMERGING US DOMESTIC MARKET

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Subsea P&A Requirements

What is P&A and what is required?

• Decommissioning of a well at end of productivity
  • Mechanical plug
  • Cement, resin, or other media plug

• For an annular space that communicates with open hole and extends to the mud line
  • A cement plug at least 200 feet long set in the annular space
  • Plug must be cross sectional
  • Plug must extend at least 200 feet above the liner top

• Pressure test each casing annulus to verify isolation.
P&A Challenge

Two Subsea Wells To P&A

• **ISOLATION REQUIRED IN MULTIPLE ANNULI:**

  • Perforate 9.625” stop short of 13.375” where possible (B)
  
  • Perforate 9.625” and 13.375” stop short of 16” at ~3000’ (C)
  
  • Perforate 9.625” and 13.375” and 16” stop short of 20” at ~2050’ (D)
Perforating Considerations

• Minimum running restrictions
  • 6.625” riser limited gun size to 5.125”

• Phased coverage
  • Required to reduce risk of cement channeling

• Target annular medium
  • Possibly fluid or cement

• Tubular orientation
  • Tubular orientation downhole was unknown

• Timeline
  • ~5 months from request to load-out
  • “D” annulus charge design, certification, and delivery

• Verification of product functionality
  • Use of proper tubular weight and grade
Charge Development

- Customer requirements
  - Hole size through 16” casing >0.20”
  - Phased coverage at multiple tubular orientation
  - <40% damage to outer casing string

- Single charge testing used for charge development
  - Provides economical means of development
  - Provides confidence in charge prior to system testing
Certification Prior to Deployment (Actual weight/grades of well casing)
Delivered System

• 5.125” HSD system
  • 360° phased system

• 0.31” average 16” casing exit hole
  • Unimpeded cement flow

• Multi-phase perforation coverage

• Negligible damage to 20” casing
  • >90% remaining casing wall
  • Contains cement within the desired annular space
  • Maintains long term integrity of outer barrier
Upper P&A Plan to Plug “D” Annulus

• Log identifies best location to circulate in the “B” Annulus and set cement plug using inflatable packer

• Plug in “C” Annulus similar to above

• Plugs not only provide barrier but also allow placement of cement plug in “D” annulus

• Punch holes into “D” Annulus and either squeeze or circulate cement plug in place
System Deployment

Schematic Representation of Annular “Support” Plugs

- Punch holes @ ~2050 in 9-5/8′-3/8"
- 30" @ ~1200'
- 20" @ ~2800'

SPOT PLUG IN C ANNULUS

- Punch 9-5/8" @ 2700'; RIH @ 1680 to 2650'; Circ Cmt in B Annulus
- RIH w ICR to 2550', Circ Cmt
- 30" @ ~1200'
- 20" @ ~2800'
Schematic Representation of “D” Annulus Plug – Squeeze Option

30” @ ~1200’

TOC @ ~2200’

20” @ ~2800’

Punched Holes @ ~2050’ thru 9-5/8” and 13-3/8”

SQUEEZE PLUG IN D ANNULUS

D - Punch to 20” Ann @ 2500, Set ICR @ 2450’; Squeeze Cement
Schematic Representation of “D” Annulus Plug – Circulate Option

30" @ ~1200'

TOC @ ~2200'

20" @ ~2800'

Punch Holes @ ~2050' thru 9-5/8", 13-3/8" and 16"

D - Punch to 20" Ann @ 2500, Set ICR @ 2450'; Spot
Successful P&A

Highlights

• Charge development and system verification completed within required timeframe

• System deployed to provide a cross-sectional plug in the required location

• Use of perforating to complete the task provided a reduction in cost
  • The P&A project was completed under budget

• Advancing P&A perforating technology by providing a custom engineered solution for “D” annulus cement placement
QUESTIONS? THANK YOU